Fish-habitat relationships in French Guiana rivers: a review

by

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ABSTRACT. - The role of habitat at different spatiotemporal scales in structuring fish communities is nowadays universally recognized. French Guiana, with a dense hydrographic network and high fish species richness, constitutes an adapted field to test some hypotheses about fish-habitat relationships. This paper aims at synthesizing the actual knowledge on the environmental variables determinant in structuring fish communities in French Guiana rivers. Historical factors linked to the alternation of glacial and inter-glacial episodes explain the peculiar distribution of fish species in an East-West gradient. The number of fish species in the basins matches the general relationship between basin area and fish richness observed in other Amazonian rivers. The zonation of fish species along the course of rivers is poorly marked with only two zones identified, excluding the headwaters which are largely unknown. At the reach scale creeks and pools house distinct fish communities but no fish species is exclusive of the rapid habitat. In the creeks as well as in the pools many statistical relationships have been found between environmental variables and the presence and/or abundance of individual fish species. Gold mining and the presence of a dam are the main human activities that influence fish communities' structure through modification of the aquatic environment.

RÉSUMÉ. - Les relations habitat-poissons dans les cours d'eau de la Guyane française : une revue.

Le rôle de l'habitat dans la structuration des communautés de poissons est actuellement largement reconnu. La Guyane française avec un réseau hydrographique dense et une richesse spécifique de poissons élevée, constitue un terrain de choix pour tester des hypothèses sur les relations entre le poisson et son habitat. L'objectif de cette étude est d'établir l'état des connaissances sur les variables environnementales déterminantes pour la structuration des communautés de poissons des cours d'eau de Guyane. Les facteurs historiques, liés à l'alternance des périodes glaciaires et interglaciaires, expliquent la distribution particulière des poissons le long d'un gradient Est-Ouest. Le nombre d'espèces dans les bassins est en accord avec la relation aire/richesse pour les fleuves sud-américains. La zonation des espèces le long du cours d'eau est peu marquée avec seulement deux zones identifiées, hors les têtes de bassin largement méconnues. A l'échelle du tronçon, les criques et les vasques abritent des peuplements distincts mais il n'y a pas d'espèces exclusives de l'habitat rapide. Dans les criques comme dans les vasques, de nombreuses relations statistiques ont été mises en évidence entre des variables environnementales et la présence et/ou l'abondance des espèces. L'extraction aurifère et la présence d'un barrage sont les principales activités humaines qui influencent la structure des peuplements de poissons à travers de profondes modifications de l'environnement.

Key words. - Fish community structure - South America - French Guiana - Streams - Quality index.

Following the stimulating work of McArthur (1958), ecologists concentrated on the role of biotic interactions and especially the influence of competition in structuring communities. It was only in the 80's that the role of habitat in structuring fish communities was intensively investigated and is nowadays universally recognized (Matthews, 1998; Winemiller *et al*., 2008). According to the habitat templet theory (Southwood, 1977, 1988), habitat constitutes the frame – the templet – that constrains the construction of complex communities through colonization, extinction and evolution processes. In that way, the composition of actual communities is partly determined by historical factors. However, local communities are also dependent of actual habitat characteristics at different spatial and temporal scales, which can mediate the biotic interactions between species. In rivers, different frameworks have been proposed for a hierarchical classification of habitats, considering spatial and temporal characteristics of a hydrographic basin (Frissel *et al*., 1986; Imhof *et al*., 1996; Poff, 1997). Generally these frameworks consider the watershed (10^5 m), the subwatershed (10^4 m), the reach (10^4-10^1 m), the site (10^{-1} m) and the habitat element (1-0.1 m). At the watershed spatial scale, the variables likely to influence fish communities are the hydrological regime, the drainage area, the discharge, the general morphology, the climate, the vegetation, among many others. The number of species present in a watershed has been shown to be linked to the size of the basin (Welcomme, 1979) and energy availability (Guegan *et al*., 1998). In addition, the composition of fish communities depends on their localization in the basin, either on a longitudinal basis (Vannote *et al*., 1980) or on a lateral one (Junk and Bayley, 1989). At lower spatial scales a number of factors affect fish

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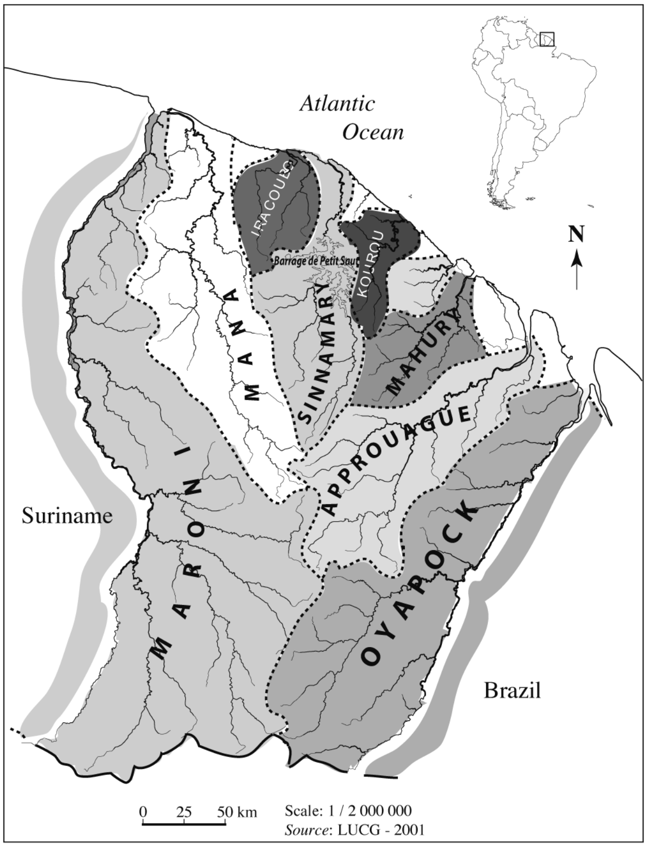
species distribution such as stream depth and width, water velocity, type of substrate, and extension of riparian vegetation cover (Bain, 1995; Matthews, 1998). Most of these relationships between habitat and fish communities have been established for temperate rivers. However it is not sure that tropical rivers function differently from temperate ones (Boulton, 2008).

With a very dense hydrographic network, a relatively unaltered landscape and high fish species diversity, French Guiana constitutes an appropriate field to test the above hypotheses on fish habitat relationships in tropical rivers. The present paper aims at synthesizing the knowledge on fish-habitat relationships in French Guiana.

Area description

French Guiana (named FG hereafter) is a French overseas department located on the Northwest side of South America and covering an area of approximately 90.000 km^2. This territory is formed by Precambrian rocks, part of the Guiana Shield. The shield slopes towards the north where it extends under the younger sediments, which form a relatively narrow coastal plain (Marteau and Vazquez-Lopez, 2001). The whole territory is almost entirely covered by a dense evergreen forest (Girou, 2001). It is drained by eight major hydrologic basins flowing south-north and many small coastal creeks (Lointier and Gaucherel, 2001) (Tab. I and Fig. 1). The two largest basins, the Maroni and the Oyapock, are boundaries with Suriname and Brazil respectively. Discharge in FG rivers varies seasonally with a seven months high water season starting in January (Fig. 2A). Large daily variations in discharge are frequent (Fig. 2B). The longitudinal profile of the main course of rivers is homogenous through the territory. In the Sinnamary River, Tito de Morais and Lauzanne (1994) identified five zones based on the slope and the presence of rapids (locally called "saut") (Fig. 3): 1) the head waters with a very high slope (0.16%) and a few low rapids (< 2 m); 2) an upstream zone with large pools and some floodable areas separated by low rapids (< 2 m) and a weak slope (0.04%); 3) a medium course with a relatively high slope (0.07%) and a close succession of high cascade-type rapids (often > 2 m), separating short pools of 1 or 2 km; 4) a downstream zone with a slight slope (< 0.006%) including large pools and some low riffles; and 5) the estuarine zone about 50 km long where tides affect daily changes in current direction and, near the mouth, lead to a saltwater wedge. The "sauts" are areas where a sudden slope breakdown leads to a brutal acceleration of water current. There, the substratum is composed of large rocks and the depth is low. Their dimension is variable from a few centimetres high to waterfalls several meters high. This habitat is seasonally variable. In high waters they can be totally covered by water and become invisible. The pools are areas where the rivers become deeper, wider and meander across its valley. Almost everywhere the banks are covered with pristine forest. The bottom, sandy in most of the course, becomes muddier as the river approaches its mouth. Creeks constitute another common habitat widespread in the whole territory. They are narrow (< 10 m), shallow (< 1 m in most parts) entirely covered by overhead vegetation which limits the light penetration. There, the substrate is composed of sand, gravel or rocks. However these common characteristics hide a great diversity of creek habitats. Tree fall creates in some places small



Source: LUCG - 2001

Figure 1. - Map of French Guiana with the delimitation of its major hydrographic basins.

Table I. - List of the major basins in French Guiana with their main characteristics. 1: estimated; 2: discharge of the Comté River branch only.

Basin	Length of main course (km)	Area (km^2)	Mean annual discharge (m^3.s^{-1})
Maroni	520	65830	1700
Oyapock	370	26820	835
Approuague	270	10250	304
Mana	430	12090	311
Sinnamary	262	6565	243
Iracoubo	140	744^1	-
Mahury	115^1	3114^1	101^2
Kourou	112	1749^1	-

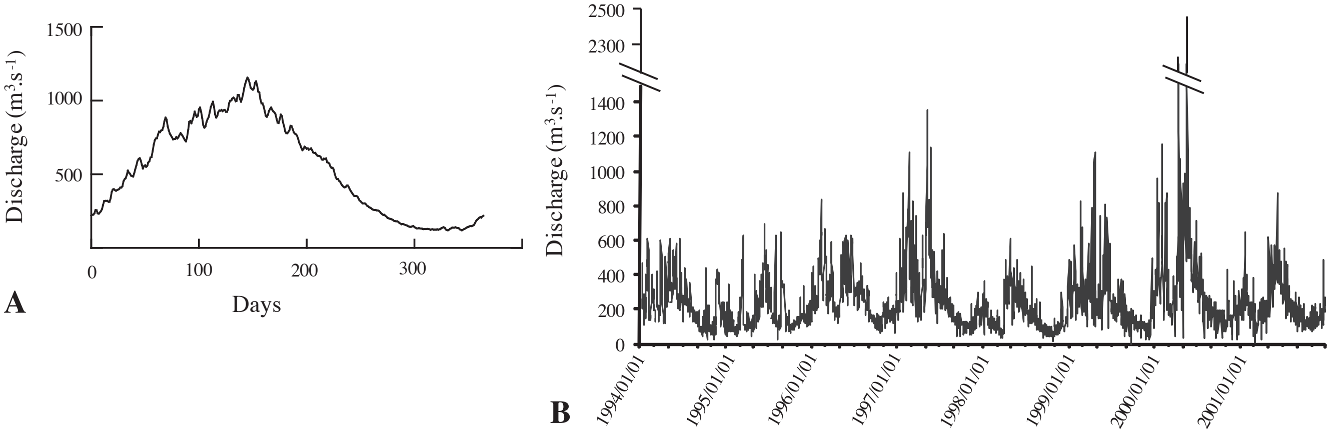


Figure 2. - Hydrograms of selected rivers in French Guiana. **A**: Mean of 27 years of daily discharges at Camopi on the Oyapock River; **B**: Daily variations of discharges at Saut Dalles station on the Sinnamary River from January 1994 to December 2001.

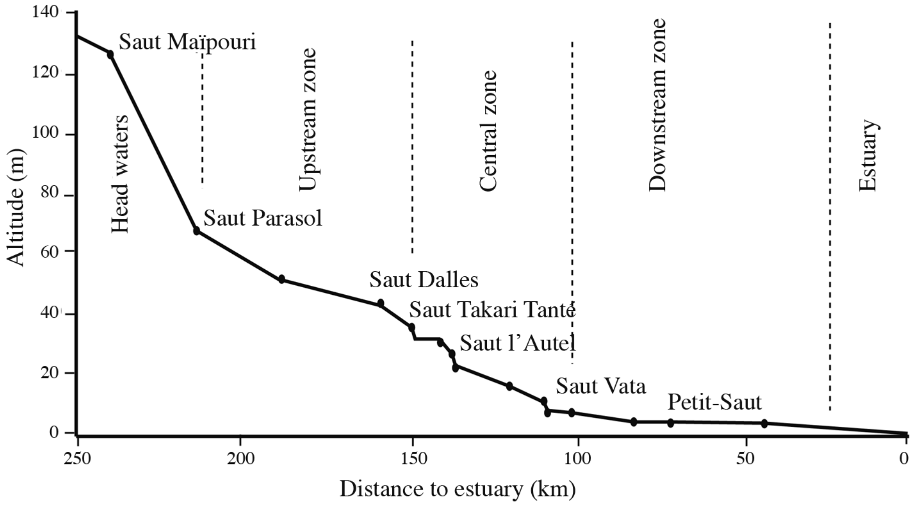


Figure 3. - Longitudinal profile of the Sinnamary River. Modified from Tito de Morais and Lauzanne, 1994.

reservoirs of still water and generates much coarse and fine organic debris. Sometimes erosion leads to undercut bank and aquatic vegetation may or may not be present. As a rule, water in FG rivers is slightly acidic and poorly conductive.

Historical factors of fish distribution in French Guiana

Rivers in FG present a high fish species richness. Recent inventories identified 482 species with a high level of endemicity (Planquette *et al.*, 1996; Meunier *et al.*, 1998; Keith *et al.*, 2000; Le Bail *et al.*, 2000). The distribution of fish species in FG rivers shows a neat separation in two main groups of faunal affinity: the group Suriname-Maroni-Mana in the West and the group Oyapock-Approuague in the East (Boujard and Tito de Morais, 1990; Mérona *et al.*, 2001). The distribution of cichlid species clearly illustrates this separation (Keith *et al.*, 2000). *Cichla ocellaris* Bloch & Schneider 1801, *Crenichla multispinosa* Pellegrin, 1903, *Geophagus harreri* Gosse, 1976, and *Guianacara owroewefi* Kullander & Nijssen 1989, are only encountered in the West, whereas *Cichla monoculus* Spix & Agassiz, 1831, *Crenicichla johanna* Heckel, 1840, *Geophagus camopiensis* Pellegrin, 1903, and *Guianacara geayi* (Pellegrin, 1902), are characteristics of the East. Moreover a genetic analysis of 193 Serrasalmid and Anostomid species shows that the Approuague and Oyapock Rivers form a different zoogeographic group than the rivers in the West, including the Suriname River in Suriname (Renno, 1989). A hypothesis related to the refuge theory has been proposed to explain this peculiar distribution. This hypothesis is based on the observation that the alternation of cold and hot periods in the quaternary led to large oscillations of sea level of more than 100m (Pujos and Odin, 1986). During the glacial periods, the sea level lowers leading to the isolation of the rivers' mouths, which are not anymore connected through littoral swamps. In that situation fish populations became isolated and vicariant speciation could act leading to genetic separation between these populations. This hypothesis has been supported by genetic analyses of *Leporinus friderici* (Bloch, 1794) evidencing two distinct forms distributed on either side of the Kourou River located in the central part of FG (Renno *et al.*, 1989; Renno *et al.*, 1990). However, it is likely that in these periods, some large rivers such as the Maroni and the Mana Rivers in the west and the Oyapock and the Approuague Rivers in the east, had a common mouth allowing free passage of fish explaining the similarity of fish fauna in these two pairs of rivers (Boujard *et al.*, 1997). During the inter-glacial periods when sea levels rose the low elevation coastal plain flooded. This situation likely allowed the passage of fish from one river to the other nearby. This hypothesis evokes the existence of two distinct sources of recent colonization: one north of the mouth of the Amazon River and the other on the Guianese plateau, west of FG. In that hypothesis, the colonization of FG rivers by Amazonian species proceeded in two directions. The first one comes from the mouth of the Amazon River, favoured by the current carrying freshwater along the coast of the Guianas (Jégu and Keith, 1999). The second one comes from the North via connections between the Essequibo River basin in Guyana and the Rio Branco sub-basin, a tributary of the Rio Negro (Mérona *et al.*, 2001; Mérona, 2005). These historic processes can explain the absence of some groups of species in the FG central basins. As an example there are no species of *Serrasalmus* either in the Sinnamary or in the Kourou Rivers, whereas the genus is present in all the other basins. According to recent analysis of the distribution of fish species in the Amazon region the historical processes described above happened probably earlier than during the Pleistocene period (Montoya-Burgos, 2003; Hubert and Renno, 2006). Another path of colonization has been recently suggested: hydrologic changes during geological periods could have allowed the passage of the Tumuc-Humac mounts, south of the Guianas, by some small fish species characteristic of headwaters (Cardoso and Montoya-Burgos, 2009).

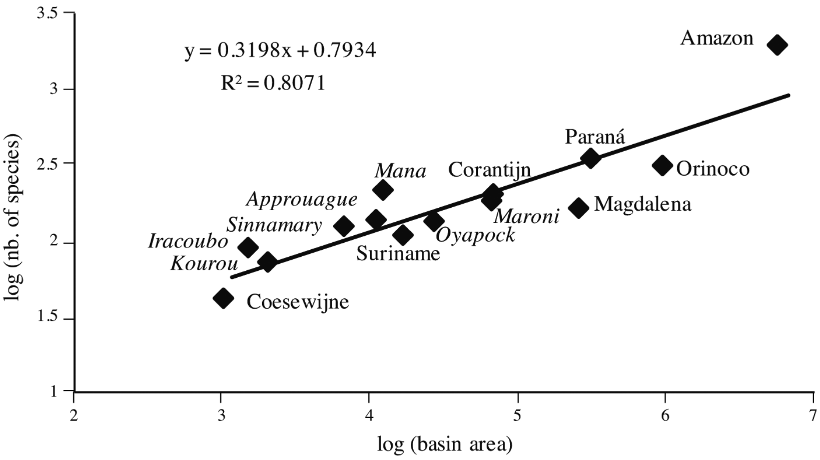


Figure 4. - Relation fish species richness and basin area for some rivers of South America. In italic French Guiana rivers. Data from Welcomme (1990), Ouboter (1993), Planquette *et al.* (1996), Keith *et al.* (2000), Le Bail *et al.* (2000).

The watershed scale

In terms of species richness, FG rivers match the general relationship between basin area and number of species (Fig. 4) (Mérona, 2005). The limited discrepancies are probably related to the difference of research effort dedicated to particular rivers. The Sinnamary and the Approuague Rivers appear to be richer than predicted by the general relation. The former was intensively studied because of the construction of a dam, which led to the development of impact studies (Boujard and Rojas-Beltran, 1988a, 1988b; Mérona and Tito de Morais, 1996, 1997; Mérona and Albert, 1999). The later was also intensively sampled as a model in the first studies on fish communities in FG conducted by the French Institut National de la Recherche Agronomique (Boujard *et al.*, 1990a, 1990b, 1990c, 1997).

The first study on the longitudinal distribution of fish in FG rivers was conducted on the Sinnamary River (Boujard and Rojas-Beltran, 1988b). From a limited data set the authors identified marked faunistic differences between three zones defined mainly by geomorphological criteria. However their samples covered only half of the entire length of the river. Later, Tito de Morais and Lauzanne (1994) found a different pattern from a more complete sampling covering more than 220 km on the 262 km of the total length of the river (i.e., excluding only the headwaters). Analysing three different habitats separately (pools, rapids and creeks), they confirmed the distinctiveness of a lower course which, according to their results, should include the two uppermost zones of Boujard and Rojas-Beltran, and observed a general homogeneity of the fish fauna in the upper and middle course. Many species appeared to be exclusively in the lower course which, as a consequence, exhibits the highest species richness. This pattern was confirmed later in studies of the distribution of juvenile fish in creeks (Ponton and Copp, 1997; Mérigoux and Ponton, 1999) where distinctive assemblages were observed in upper versus lower water courses. Lower courses were characterized by lower density, higher species richness and many species not found in the upper courses. Among the most abundant species in the samples of the upstream zone were *Hemiodus quadrimaculatus* Pellegrin, 1908*, Parodon guianensis* Géry, 1959*, Chilodus zunevei* Puyo, 1946 and *Leporinus despaxi* Puyo, 1943. Conversely some abundant species were only captured downstream such as *Dormitator macrophtalmus* (Bloch, 1792)*, Eleotris amblyopsis* (Cope, 1871)*, Parauchenipterus (Trachelyopterus) galeatus* (Linnaeus, 1766)*, Gasteropelecus sternicla* (Linnaeus, 1758) and *Charax pauciradiatus* (Günther, 1864).

The reach scale

At the reach scale, habitat structures fish communities either through its spatial heterogeneity or its temporal variability. In the Arataye River, an affluent of the Approuague River, a space-time organization of fish assemblages has been identified (Boujard *et al*., 1990c). These authors defined five different habitats in a reach of a few kilometres: the creeks, the rapids and three different pool habitats depending of bank geomorphology (sedimentary, eroded or intermediary). In the low water season, the creek habitat housed a small number of species, *Bryconops affinis* (Günther, 1864) being the most abundant. However, in the high water season a large number of species inhabited this habitat and *Myleus ternetzi* (Norman, 1929), and *Hoplias malabaricus* (Bloch, 1784) became the most abundant at the same time as their abundances diminished in the main course of the river. The rapid habitat was colonized by a rich and diverse community with three dominant species: *Hypostomus gymnorhynchus* (Norman, 1926)*, Moenkhausia* cf. *intermedia* Eigenmann, 1908, and *Geophagus camopiensis*. The three pool biotopes were more homogenous in their fish assemblages. There were no species characteristic of each of these habitats and the only notable difference between them was the lower relative proportion of small species in the pool habitats with sedimentary banks versus pool habitat with eroded banks. In their study on the longitudinal zonation of fish in the Sinnamary River Tito de Morais and Lauzanne (1994) sampled separately the three main habitats encountered along the course of the river. Although the objective of the study was not to detect reach scale fish-habitat relationships, they gave a complete table of the presence of species for each habitat and each reach. These data show that some species appeared exclusively in creeks or pools, but, surprisingly enough, there were no species exclusively in the rapid habitat. This is probably related to the seasonal variability of the rapids, which can completely disappear in the high water season, an event that maintains spatial continuity in the rapid-pool succession. In FG rivers, floodplains are of very limited extent as attested to by the distribution of vegetation types (Granville, 2001). Floodplain habitat occurs in the upper course of the Sinnamary River where the distribution of fish species was studied (Tito de Morais *et al*., 1995). In the flooded forest the fish fauna was mostly composed of juveniles and adults of small species.

The local habitat scale

Two macro-habitats were particularly studied in order to detect effects of local habitat characteristics on fish communities: creeks and pools.

An intensive research program was pursued in the 1990's on fish/habitat relationships in the creeks of the Sinnamary River basin (Ponton, 1994; Ponton and Tito de Morais, 1994; Mérigoux and Ponton, 1997; Ponton and Copp, 1997; Ponton and Vauchel, 1998; Mérigoux *et al*., 1999; Mérigoux and Ponton, 1999; Ponton and Mérigoux, 2000; Ponton *et al*., 2000; Ponton and Mérigoux, 2001). In these environments, most of the fish captured were young stages as attested to by the proportion of juveniles (>90%) in the collections made in 30 sites distributed along the course of the Sinnamary river (Ponton and Copp, 1997). The studies revealed strong and complex interactions between both spatial and temporal habitat characteristics and young fish assemblages (Mérigoux and Ponton, 1999). Dissolved oxygen concentration, turbidity, habitat structure and proximity of the main channel were important variables in explaining the spatial variation in density. Temporal variation of density appeared to be strongly dependent of hydrological events. However, responses to habitat were not homogenous among the different taxa. Those with reproductive habits relatively independent of abiotic factors [i.e., equilibrium strategists sensu Winemiller (1989, 1992)] did not show much density variation with hydrology. More generally, although the functional structure of young fish communities based on reproductive guilds could not be related to spatiotemporal variability of habitat, individual life-history traits appeared to be correlated to habitat variables such as mean water level, dissolved oxygen or mean width (Mérigoux *et al*., 2001). This complexity probably partially explains the difficulty in predicting young fish communities' diversity from spatiotemporal features of the habitat (Mérigoux *et al*., 1999). The authors hypothesized that this lack of prediction was due to the large number of rare species in the communities.

Marginal areas of the main course of two coastal rivers were studied to investigate the relationship between habitat characteristics and fish assemblages (Mérigoux *et al*., 1998). The results show a strong correlation between habitat diversity and fish species richness. Distribution of fish species in the marginal areas of coastal rivers depends mainly on habitat structure (bank length, canopy cover, and aquatic vegetation), conductivity and dissolved oxygen concentration.

In the pools of the main course of large rivers also, numerous correlations have been observed between adult fish communities and habitat variables (Tejerina-Garro, 2001). Despite a subjective impression that aquatic habitats are homogeneous in FG territory almost entirely covered by pristine forest, a number of variables showed an important spatial variability (Tejerina-Garro and Mérona, 2001). Channel width, water temperature, channel depth, water transparency and conductivity have been shown to differentiate 16 sites in different rivers of the territory. In order to eliminate the taxonomic component of fish communities, functional descriptors were used to seek the effects of habitat on their structure. Detritivores and omnivores were associated with elevated conductivity and temperature, large piscivores with high water transparency. The latter association highlights the importance of vision in the feeding strategy of some piscivores (Rodriguez and Lewis, 1997; Tejerina-Garro *et al.*, 1998). Fish communities' structure in FG large rivers has been shown to be affected also by the temporal variability of the environment (Tejerina-Garro, 2001; Tejerina Garro and Mérona, 2010). Samples conducted every two months during two consecutive years in two stations of the Comté River revealed a strong correlation between water level and the structure of fish communities. Indeed, water level is correlated with many other environmental variables, and among them, water conductivity, level of dissolved oxygen, channel depth and width and bank structure, showed a significant contribution to the relationship between habitat and communities (Tejerina-Garro, 2001). Seasonal changes in fish community structure following habitat changes was related to the movement of fish in search of more favourable conditions either for feeding or for reproduction (Levêque, 1995).

Impact of perturbations induced by human activities

In the 1990's, when the above studies were conducted, most of the linear of FG rivers was still unaffected by human activities. However, in recent years the expansion of illegal gold mining activities has damaged river habitats at a worrying scale. Other sources of human impact include a dam on the Sinnamary River, two areas of concentrated mechanized agriculture, diffuse human settlements along the two main rivers (Oyapock and Maroni) and the site of the European Spatial Center near the town of Kourou (Mérona *et al.*, 2001).

Although the dramatic increase of suspended matter downstream from gold mining sites is well known, there is no published study in FG analysing changes in fish-habitat relationship relative to gold mining perturbation. However, some sporadic observations show a probable impact of the increased amount of suspended matter in the water column on the richness and diversity of fish communities (Vigouroux *et al.*, 2006). In Suriname, the western neighbour of FG, it has been documented that erosion related to small-scale gold mining reduces fish diversity and shifts community structure because of increased turbidity and a reduction of instream habitat diversity (Mol and Ouboter, 2004). Moreover many surveys have shown an increase of mercury concentration in fish related to gold mining (Frery *et al.*, 2001; Mol *et al.*, 2001; Roulet and Maury Brachet, 2001; Maury-Brachet *et al.*, 2006).

Hydroelectric dams are known to alter downstream aquatic habitat in various ways. First of all they disturb the natural flow regime with severe short-term flow fluctuations and an overall reduction of the amplitude of the annual flow pattern. Dams modify also the water quality downstream, lowering the level of nutrient load and dissolved oxygen concentration. In the first years following Petit-Saut Dam closure there was a drop in dissolved oxygen concentration downstream that led to large movements of fish populations towards the more oxygenated waters near the dam (Mérona and Albert, 1999). In the same time the absence of the annual flood affected the survival of the young of many species because of the lack of marginal flooded areas favourable to their survival (Ponton and Copp, 1997; Ponton and Vauchel, 1998). Later on, when water quality improved and a regular hydrologic regime was restored, the fish species richness diminished and the trophic structure of the adult communities was deeply altered in favour of autotrophic feeders (Mérona *et al.*, 2005).

Application of the fish-habitat relationship for biomonitoring of rivers

The large bulk of information on fish-habitat relationships has been used in a tentative to construct a quality index of FG rivers (Tejerina-Garro *et al.*, 2006). This index was based on the same theoretical principles that prevailed for the elaboration of European fish indices for the European Water Framework Directory. In summary the authors proceeded in three steps: 1) establish statistical relationships between habitat variables and fish community descriptors in unaffected sites in order to account for the natural variability; 2) select fish community descriptors sensible to perturbations, which are those that statistically deviate from the above relation and 3) normalize and sum these descriptors resulting in a multimetric quality index. Although the validity of this preliminary index is debatable due to the relatively low number of sites sampled (27), the results seem promising given that they match expectations from classical ecological theory. In short, perturbation was shown to decrease abundance and diversity, and the number of specialized predators (piscivores and invertivores), and increase the number of omnivorous species.

DISCUSSION

According to Géry (1969), the Guianas, along with the central Amazon, form a unique ichthyofaunal region. This is supported by the great similarities between the fish fauna of Guiana's rivers and the Amazon itself and the presence of connections in the headwaters of rivers. From the observation that peripheral streams of the Amazon Basin share many species and that the Amazon River represents an ecological barrier to many small fish species, Lowe-McConnell (1991) suggested that a primitive fauna spread out from the Guiana Shield around the Amazon basin and that the rich fauna of the Amazon proper diversified later. Although recent biogeographic analyses evidence much more complex mechanisms of fish species dispersion in the Amazon region (Hubert and Renno, 2006), this hypothesis could explain the high species richness of the central basins of French Guiana despite the limitation of the more recent colonization process from the Amazon basin to the Guianese rivers (Jégu and Keith, 1999).

Longitudinal zonation of rivers in the North Temperate hemisphere allows the identification of zones characterized by particular species (Illies and Botosaneanu, 1963; Verneaux, 1976). However this pattern is hardly transferred to tropical water courses. In Africa this pattern applies only to a few high altitude rivers (Harrison, 1965). Like the pattern observed in the Sinnamary River, most of West African rivers present a homogeneous distribution of fishes along their courses and the progression from the head waters to the estuary is marked by an addition of species instead of a substitution (Sydenham, 1977; Mérona, 1979, 1981; Welcomme and Mérona, 1988).

According to the limited set of data available from rivers in FG, there is no neat boundary between fish communities of pools and riffles. Depending on the situation and scale of observation, the strength of macro habitat association for stream fish is variable. At a large spatial scale (74 sites in Oklahoma and Arkansas, USA) but a limited time period (March to June 1993), Taylor (2000) observed different fish communities in pools and in riffles. However, other studies covering different seasons failed in demonstrating strong associations between fish and the Pool-Riffle continuum (Bart, 1989). The fact that riffles are very variable environments, particularly in tropical rivers where large variations in water level occur seasonally, could explain the lack of clear differentiation of pool and riffle fish communities.

With the exception of temperature, a parameter almost constant in equatorial regions, every local environmental variable found to be associated with fish community structure in FG has already been pointed out as determinant of fish distribution in temperate rivers (Matthews, 1998). This situation allowed the use of fish-habitat relationships to construct indices of quality for rivers. FG, as an ultraperipheric French administrative unit, is subject to application of the European Water Framework Directive that requires the restoration and maintenance of "healthy" aquatic ecosystems. To meet this requirement biological tools are needed to measure the "health" of rivers. Elaboration of these tools requires a detailed understanding of the patterns of organism assemblage composition and distribution within and among water bodies under natural conditions and also of an understanding of the major environmental gradients that cause these patterns (Oberdorff *et al*., 2002). Of course, the actual knowledge of fish ecology in FG rivers is far from complete due to the limited research effort in the region in relation to the high number of species and the consequent complexity of communities. However, the approach adopted by Tejerina-Garro *et al*. (2006) will permit progressive improvement of the index as future iterations build upon an ever-increasing database.

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